E.O. Lawrence Berkeley National Laboratory
University of California
Environmental Restoration Program

United States Department of Energy

Soil Management Plan

for the Lawrence Berkeley National Laboratory

ENVIRONMENTAL RESTORATION PROGRAM

September 2006

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Soil Management Plan

for the

Lawrence Berkeley National Laboratory

ENVIRONMENTAL RESTORATION PROGRAM

A Joint Effort of
Environment, Health and Safety Division and
Earth Sciences Division
Lawrence Berkeley National Laboratory
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Berkeley, CA 94720

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CONTENTS

LIST OF ABBREVIATIONS

AOC	Areas of Concern
Berkeley Lab	Lawrence Berkeley National Laboratory
CAP	Corrective Action Program
CVOCs	Chlorinated Volatile Organic Compounds
CMS	Corrective Measures Study
CMI	Corrective Measures Implementation
COC	Chemical of Concern
DCA	Dichloroethane
DCE	Dichloroethene
DOE	United States Department of Energy
DTSC	Cal/EPA Department of Toxic Substances Control
ERA	Ecological Risk Assessment
ERP	Environmental Restoration Program
ESG	Environmental Services Group
HHRA	Human Health Risk Assessment
HI	Hazard Index
ICM	Interim Corrective Measure
ILCR	Incremental Lifetime Cancer Risk
IC	Institutional Control
LLRW	Low Level Radioactive Waste
MCS	Media Cleanup Standard
NFA	No Further Action
NFI	No Further Investigation
NTLF	National Tritium Labelling Facility
OEHHA	Office of Environmental Health Hazard Assessment
OSHA	Occupational Safety and Health Administration
PAHs	Polynuclear Aromatic Hydrocarbons
PCBs	Polychlorinated biphenyls
PCE	Tetrachloroethene
PRG	Preliminary Remediation Goal
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility investigation
SMP	Soil Management Plan
SWMU	Solid Waste Management Unit
SVOCs	Semi-volatile Organic Compounds
TCA	Trichloroethane
TCE	Trichloroethene
TSCA	Toxic Substances Control Act
UCL	Upper Confidence Limit
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank

SECTION 1

INTRODUCTION

1.1 PURPOSE AND ORGANIZATION

This Soil Management Plan (SMP) describes specific institutional controls (ICs) for soil required for compliance with the Ernest Orlando Lawrence Berkeley National Laboratory's (Berkeley Lab) Resource Conservation and Recovery Act (RCRA) Part B Permit. These controls are based on the corrective measures recommended in the RCRA Corrective Measures Study (CMS) Report (Berkeley Lab, 2005), which was prepared as part of the RCRA Corrective Action Program (CAP). Preparation and implementation of the SMP is part of the Corrective Measures Implementation (CMI) phase of the CAP.

The SMP contains descriptions of the following elements:

- the distribution of soil contaminants at Berkeley Lab
- institutional controls, including primarily land-use restrictions that will be used to reduce potential risks from exposures associated with contaminated soil and reduce the potential for environmental impacts
- procedures for the management and disposal of waste soils generated during construction activities or other activities that might disturb contaminated soil at Berkeley Lab.

1.2 BACKGROUND

As a result of Berkeley Lab's mission as a research facility, many types of chemicals have been used or produced as wastes over the more than 60 years of operation. These include solvents, polychlorinated biphenyls (PCBs), gasoline, diesel, waste oil, and metals. Additionally, radionuclides have been used or produced as waste at Berkeley Lab. Some of these chemicals have been released to the environment. These releases originated from spills and leaks that mostly occurred decades ago. Since that time, Berkeley Lab has implemented numerous internal requirements to protect the environment. These requirements are specified in specific documents, including: Environmental Monitoring Plan; Spill, Prevention, Control, and Countermeasure Plan; Health and Safety Plan; Integrated Safety Management Plan; Accidental Spill Prevention and Containment Plan; and the Storm Water Pollution Prevention Plan. In addition, Berkeley Lab has an extensive staff-training program. The following training is required for generators of hazardous wastes.

- EHS 604, Hazardous Waste Generator Training, is required for all generators of hazardous waste at Berkeley Lab.
- EHS 610, Waste Accumulation Area (WAA) Supervisor's Training, is required for WAA managers at Berkeley Lab.
- EHS 614, Satellite Accumulation Area (SAA) Management, is required of researchers and others who generate hazardous and mixed wastes and who are responsible for management of SAAs.

1.3 RCRA CORRECTIVE ACTION PROGRAM

Berkeley Lab’s RCRA Hazardous Waste Facility Permit required that Berkeley Lab investigate and address the historical chemical releases (not including radionuclides) in accordance with the RCRA CAP requirements. The Permit is issued and enforced by the California Environmental Protection Agency Department of Toxic Substances Control (DTSC), including the activities required under the RCRA CAP. The Environmental Restoration Program (ERP) has been the Berkeley Lab program responsible for investigating and addressing the historical chemical releases under the CAP. The ERP has been part of a nationwide effort by the United States Department of Energy (DOE) to identify and clean up contaminated areas at its facilities.

The primary components of the RCRA CAP are:

- RCRA Facility Assessment (RFA)
- RCRA Facility Investigation (RFI)
- Corrective Measures Study (CMS)
- Corrective Measures Implementation (CMI).

The RFA, which was completed in 1992, and the RFI, which was completed in 2000, comprised the investigation phase of the CAP. The purpose of the RFA was to identify known and potential past releases of hazardous waste and hazardous constituents to the environment from Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs) at Berkeley Lab. SWMUs, AOCs, and other areas of known or potential release of contaminants are collectively referred to as “units” in this report.

SWMUs identified at Berkeley Lab included above-ground and underground waste storage tanks, sumps, scrap yards, plating shops, the former hazardous waste handling facility, waste accumulation areas, hazardous waste storage areas, and waste treatment units. AOCs identified at Berkeley Lab primarily included chemical product storage tanks (e.g., fuel tanks), transformers, and hazardous materials storage areas. Areas of groundwater contamination were also considered as AOCs.

Results of the RFA are provided in the *RCRA Facility Assessment at the Lawrence Berkeley Laboratory* (Berkeley Lab, 1992). The RFA found that hazardous waste or hazardous constituents had been released to soil and groundwater. Based on these findings, DTSC concluded that an RFI was required to characterize areas at the site where releases had occurred.

The RFI, which was conducted between October 1992 and September 2000, included identification of the source and nature of the contaminants that had been released to the environment, and characterization of the magnitude and extent of those releases. The RFI was divided into three phases. The *RCRA Facility Investigation Phase I Progress Report* (Berkeley Lab, 1994) and the *RCRA Facility Investigation Phase II Progress Report* (Berkeley Lab, 1995) provided results for the first two phases of the RFI. The *RCRA Facility Investigation* (*RFI) Report* described the results of the final phase, and was submitted to the DTSC on September 29, 2000 (Berkeley Lab, 2000). A listing of the units evaluated during the RFI is provided in Table 1. The locations of the units are shown on Figure 1.

Table 1

Summary of Units Included in RFI

Table 1

Summary of Units Included in RFI (cont'd.)

Table 1

Summary of Units Included in RFI (cont'd.)

As described in the RFI reports, the principal chemical contaminants in the soil at Berkeley Lab are chlorinated volatile organic compounds (CVOCs) and PCBs. The CVOCs include primarily tetrachloroethene (PCE), trichloroethene (TCE), carbon tetrachloride, 1,1-dichloroethene (1,1-DCE), *cis*-1,2-dichloroethene (*cis*-1,2-DCE), 1,1,1-trichloroethane (TCA), and 1,1-dichloroethane (DCA). Most of these CVOCs are solvents (and their degradation products) that were used as degreasers for cleaning equipment at Berkeley Lab. PCB contamination was primarily associated with spilled transformer oils and former waste oil tanks. Other contaminants that were detected in soil include petroleum hydrocarbons (mainly associated with former underground storage tank [UST] sites) and metals (mainly associated with plating shops); and to a much lesser extent semi-volatile organic compounds (SVOCs), polynuclear aromatic hydrocarbons (PAHs), and pesticides.

During the RFI, Berkeley Lab implemented a screening process for each of the investigated units with contaminated soil to determine where further action was required. The screening process consisted of a comparison between the maximum concentration of each chemical detected in soil at each unit to the California-modified Preliminary Remediation Goals (PRGs) and United States Environmental Protection Agency (USEPA) Region 9 PRGs for residential soil. Concentrations of naturally occurring inorganic elements were also compared to Berkeley Lab background levels for soil (Berkeley Lab, 2002a). Those units that failed the screening process were considered to pose a potential risk to human health, and were designated as No Further Investigation (NFI) status by the DTSC. Those units that passed the screening process were considered to pose an insignificant risk to human health, and were therefore designated by the DTSC for No Further Action (NFA). The units that passed the screening process are listed in Table 1. Those units are considered acceptable for unrestricted land use (including residential use).

Based on results of the RFI, including the screening process described above, the DTSC determined that a Corrective Measures Study (CMS) would be required because chemicals detected in the soil and groundwater at Berkeley Lab posed a potential threat to human health or the environment. The soil units where it had been determined that there was a potential risk to human health (units designated as NFI) were included in the CMS, as well as areas of groundwater contamination. As the initial step in the CMS, Berkeley Lab completed both an Ecological and a

Human Health Risk Assessment (ERA and HHRA) (Berkeley Lab, 2002b and 2003a). The ERA provided estimates of risks to plants and animals based on an evaluation of potentially completed contaminant migration pathways to ecological receptors that could be present within habitat areas at Berkeley Lab. Based on this evaluation, it was concluded that no hazards existed to plants or animals from exposure to chemicals in soil, groundwater, or surface water at Berkeley Lab.

The risk estimates provided in the HHRA are based on an industrial-type institutional use scenario for Berkeley Lab. This scenario is considered to represent the current use, and the reasonable and likely future use for the facility. The HHRA included estimates of risk to humans for each unit that had been designated for NFI status. In addition, risk estimates were provided for four additional units that had been designated for NFA status. The additional units were included because either additional samples collected subsequent to the RFI exceeded PRGs, or because PRG values for some chemicals had been updated. The units evaluated in the HHRA are noted in Table 1.

The HHRA concluded that four of the areas of soil contamination posed a potential risk to the health of institutional workers. These four units were:

- The Building 88 Hydraulic Gate Unit
- The Building 75 Former Hazardous Waste Handling and Storage Facility
- The Building 7 Sump
- The Building 51L Groundwater Solvent Plume Source Area.

The chemicals of concern (COCs) at Building 88 and Building 75 were PCBs. Subsequent to the HHRA, soil at these units was cleaned up under an Interim Corrective Measure (ICM) to the Toxic Substances Control Act (TSCA) self-implementing cleanup level of 1 mg/kg for soil in high occupancy areas. This is the Media Cleanup Standard (MCS) for PCBs specified in the CMS Report, and is a level that is considered safe for unrestricted land use (including residential use). The Building 51L Groundwater Solvent Plume Source Area and the Former Building 7 Sump will be cleaned up to an institutional land-use level during the CMI phase according to the method specified in the CMS report (excavation and offsite disposal of contaminated soil).

1.4 RADIONUCLIDES

Concurrently with the investigation and assessment of chemical releases, Berkeley Lab investigated potential releases of radionuclides from eight units, under the regulatory authority of the DOE. The eight radiological units are listed in Table 1.

Results of the radiological investigations are provided in the *Summary of Radionuclide Investigations* report (Berkeley Lab, 2003b). As described in that report, the principal radionuclide contaminants in the soil at Berkeley Lab are tritium and curium-244. The tritium is present in the soil near Building 75 as a result of past emissions from the former National Tritium Labelling Facility (NTLF). The NTLF operated for almost 20 years until December 2001. The curium-244 is present in the soil near Building 71 as a result of a release that occurred inside the building in 1959.

Based on the information provided in the *Summary of Radionuclide Investigations* report (Berkeley Lab, 2003b), the DOE concurred with Berkeley Lab that the radiological units should be assigned NFA status. However, DOE also specified that for the two units at Building 74 it was not releasing the structure, equipment, or area from any existing controls; and for five other units (units at Buildings 71, 5 [two units], 4, and 75) release of the areas to the general public was not authorized. The eighth area, the Building 75A Radioactive Waste Storage Area, was specifically designated by Berkeley Lab for reuse by the Berkeley Lab Radiation Protection Group. The locations of the eight areas are shown on Figure 1.

SECTION 2

LAND-USE RESTRICTIONS

2.1 CHEMICAL CONTAMINATION

2.1.1 Land Use and Cleanup Levels

Both the HHRA and CMS Report were completed based on the assumption that Berkeley Lab would continue to operate as a research laboratory for the foreseeable future, a scenario that is consistent with the current and reasonably anticipated future land use at Berkeley Lab. This institutional/industrial land-use scenario was therefore used for the primary risk evaluations in the HHRA and the determination of the required cleanup levels for soil and groundwater in the CMS Report. Areas of contamination that pose a potential risk to institutional workers are therefore being cleaned up to an institutional/industrial land-use level. Subordinate to the institutional land-use evaluation, the HHRA also provided a risk evaluation based on a hypothetical (and unlikely) restricted residential land-use scenario (i.e., assessing risks to residents but assuming that domestic use of site groundwater would not occur). Results of the HHRA are summarized in Table 2.

DTSC has required corrective measures for those areas where chemical concentrations in soil or groundwater result in theoretical Incremental Lifetime Cancer Risks (ILCRs) greater than or equal to 10^{-6} or Hazard Indices (HIs) greater than or equal to 1.0 (in the absence of mitigating factors) for the institutional land-use scenario. The theoretical ILCR is an estimate of the chance of contracting cancer over a lifetime of exposure. The Hazard Index (HI) is a threshold level that indicates the concentrations above which non-cancer health effects may occur. Exposure to chemicals with an HI below 1.0 is considered unlikely to result in adverse non-cancer health effects over a lifetime of exposure.

USEPA considers an ILCR anywhere within the target range for risk managers (also known as the risk management range) of 10^{-4} (one-chance-in-ten-thousand) to 10^{-6} (one-chance-in-a-million) to be safe and protective of public health. The target cleanup levels were set at concentrations that resulted in the lowest reasonably achievable ILCR level within the risk management range (i.e., 10^{-6}) and a Hazard Index (HI) of 1.0.

In addition to consideration of human health, corrective measures are required where soil contaminant concentrations could result in groundwater contaminant concentrations exceeding Maximum Contaminant Levels (MCLs) for drinking water in those areas where groundwater yields are sufficient to provide a potential drinking water supply. This addresses the State Water Resources Control Board (SWRCB) non-degradation policy (Resolution 68-16) under the Porter-Cologne Water Quality Control Act.

2.1.2 Institutional Use Restrictions

Institutional land use restrictions for soil are not currently anticipated following completion of corrective measures in 2006. However, since chemical concentrations currently exceed upper limit MCSs ($>10^{-4}$) at two units (Former Building 7 Sump and Building 51L Groundwater Solvent Plume Source Area), land use restrictions will be implemented if ILCRs still exceed the risk management range (i.e., $>10^{-4}$) following completion of corrective measures. If cleanup does not achieve the required MCSs, new buildings or other improvements intended for human occupancy may not be constructed at these locations until the target MCSs are achieved, or one or more of the following conditions are met:

- COC concentrations are lower than upper-limit MCSs
- mitigation methods are implemented to ensure that risks to future building occupants are within acceptable levels
- additional data are collected to document that risks to human health would be within acceptable levels.

Mitigation methods might include engineering controls used to eliminate contaminant migration pathways. Typically, such controls include installation of contaminant-resistant subslab organic-vapor barriers, lateral routing of utilities to avoid vapor barrier penetration, sealing of utility penetrations, and/or subslab ventilation systems (DTSC, 2004). Any mitigation measures implemented would require the approval of the DTSC. In addition, post-construction soil-gas and/or indoor air monitoring should be considered to document that risks to indoor workers are within acceptable levels.

Since the primary risk driver at the two units is due to the potential for infiltration of vapor volatilized from soil migrating into indoor air, soil gas samples could be collected to provide a more accurate estimate of risk than was derived based on the soil sampling results. Any soil-gas sampling should be conducted in accordance with guidelines specified in the DTSC Interim Final Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air (DTSC, 2004). The soil gas data should be compared to the most recent California Environmental Protection Agency (Cal/EPA) soil gas screening numbers (OEHHA, 2005) (or other applicable and appropriate screening numbers available) to assess whether risks exceed the screening levels.

2.1.3 Residential Use Restrictions

Results of the supplemental HHRA residential risk evaluation are used as the basis for restrictions proposed on hypothetical future residential land use in this plan. Residential land use restrictions are proposed where the theoretical ILCR is greater than or equal to 10^{-6} or the HI is greater than or equal to 1 for a hypothetical future resident.

Results of the HHRA's residential-risk evaluation are summarized in Table 2, and indicate that chemical concentrations in the soil at 18 units pose a potential risk to hypothetical future residential receptors, based on the conservative evaluation of risk provided in the HHRA. In addition, concentrations of contaminants exceeded PRGs for residential soil at two Berkeley Lab construction sites (Building 56 and Building 58) and the Building 71B lobe source area, which were not evaluated in the HHRA. The locations of these 21 units, which are designated "no" for residential use in Table 2, are shown on Figure 2. These 21 units are considered unsuitable for unrestricted land use unless measures are implemented to mitigate the risk or additional data are collected to show that the risk is within acceptable levels.

Table 2

Summary of Risk Assessment Results for Soil Pathways
Lawrence Berkeley National Laboratory

Unit Name	Area (a)	Unit Number	Location Reference Number (a)	Is Unit Acceptable for Residential Land Use (b)	Is Unit Acceptable for Institutional Land Use (c)	Primary Soil Risk Driver
Building 7 Former Plating Shop	OT	SWMU 2-1	1	**no**	yes	Inhalation of vinyl chloride via migration into indoor air.
Building 52B Abandoned Liquid Waste Above-Ground Storage Tank (AST) and Sump	OT	SWMU 2-2	2	**no**	yes	Ingestion of benzo(a)pyrene.
Building 17 Former Scrap Yard and Drum Storage Area	OT	SWMU 2-3	3	**no**	yes	PCBs via ingestion and dermal contact. (risk=1.03×10^{-6})
Building 69A Former Hazardous Materials Storage and Delivery Area	SS	SWMU 3-1	4	yes	yes	None
Building 69A Storage Area Sump	SS	SWMU 3-5	7	**no**	yes	Ingestion of dieldrin.
Building 75 Former Hazardous Waste Handling and Storage Facility	SS	SWMU 3-6	8	yes	yes	None
Building 76 Motor Pool and Collection Trenches and Sump	SS	SWMU 4-3	10	**no**	yes	Inhalation of benzene and PCE via migration into indoor air.
Building 76 Present and Former Waste Accumulation Area #3	SS	SWMU 4-6	11	**no**	yes	Ingestion of cadmium. Cadmium was detected slightly above background in one sample.
Building 77 Plating Shop	SS	SWMU 5-4	13	**no**	yes	Inhalation of benzene via migration into indoor air. Benzene was detected in only 1 of 25 samples. Risks are significantly overestimated.
Building 77 Former Yard Decontamination Area	SS	SWMU 5-10	17	**no**	yes	Inhalation of CVOCs via migration into indoor air.
Building 51 Vacuum Pump Room Sump and Collection Basins	B	SWMU 9-4	23	**no**	yes	Inhalation of benzene via migration into indoor air.
Building 51 Motor Generator Room Filter Sump	B	SWMU 9-6	24	**no**	yes	Inhalation of CVOCs via migration into indoor air.
Building 16 Former Waste Accumulation Area	OT	SWMU 10-4	25	**no**	yes	Ingestion of cadmium. Cadmium was detected above background in 1 of 39 samples. Risk is probably overestimated.
Building 25 Plating Shop Floor Drains	OT	SWMU 10-10	27	yes	yes	None
Building 50 Inactive Underground Residual Photographic Solution Storage Tank (TK-09-50)	WO	SWMU 12-1	28	yes	yes	None

Table 2 (cont'd.)

Summary of Risk Assessment Results for Residential Land Use Scenario for Soil Pathways
Lawrence Berkeley National Laboratory

Unit Name	Area (a)	Unit Number	Location Reference Number (a)	Is Unit Acceptable for Residential Land Use (b)	Is Unit Acceptable for Institutional Land Use (c)	Primary Soil Risk Driver
Building 7E Former Underground Storage Tank (UST)	OT	AOC 2-1	35	**no**	yes	Inhalation of VOCs via migration into indoor air.
Building 7 Former Hazardous Materials Storage Area	OT	AOC 2-2	36	yes	yes	None
Former Building 7 Sump	OT	AOC 2-5	37	**no**	**no**	Inhalation of CVOCs via migration into indoor air.
Building 88 Hydraulic Gate Unit	WO	AOC 6-3	46	yes	yes	None
Building 46 Hazardous Materials Storage Area	OT	AOC 7-3	49	yes	yes	None
Building 58 Former Hazardous Materials Storage Area	OT	AOC 7-6	50	yes	yes	None
Building 58/Building 70 Sanitary Sewer	WO	AOC 8-6	56	**no**	yes	Inhalation of methylene chloride via migration into indoor air.
Building 51 Sanitary Sewer and Drainage System	B	AOC 9-9	61	**no**	yes	Ingestion of/dermal contact with PCBs and inhalation of CVOCs via migration into indoor air.
Buildings 51/64 Former Temporary Equipment Storage Area	B	AOC 9-12	64	**no**	yes	Inhalation of CVOCs via migration into indoor air.
Building 52 Former Hazardous Materials Storage Area	OT	AOC 10-2	65	**no**	yes	Inhalation of chloroform via migration into indoor air.
Building 62 Hazardous Materials Storage Area	SEO	AOC 13-1	72	yes	yes	None
Building 37 Proposed Electrical Substation	OT	AOC 14-7	79	yes	yes	None
Slope West of Building 53	OT	not designated	80	yes	yes	None
Building 51L Groundwater Plume Source Area	B	not designated	81	**no**	**no**	Inhalation of CVOCs via migration into indoor air.
Building 71B Lobe Source Area	B	not designated	83	**no**	yes	Not evaluated in HHRA
Building 56 Construction Site	B	not designated	87	**no**	yes	Not evaluated in HHRA
Building 58 Electrical Substation Construction Site	OT	not designated	89	**no**	yes	Not evaluated in HHRA

(a) Locations are shown on Figure 1. B: Bevalac, OT: Old Town, SS: Support Services, WO: Western Outlying Area; SO Southeastern Outlying Area

(b) "No" indicates Theoretical Incremental Lifetime Cancer Risk (ILCR) exceeds 10^{-6} or the Hazard Index (HI) equals or exceeds 1.0 for residential land use for soil pathway

(c) "No" indicates soil concentrations exceed upper-limit Media Cleanup Standards, indicative of theoretical Incremental Lifetime Cancer Risk (ILCR) greater than 10^{-4} or the Hazard Index (HI) greater than or equal to 1.0 for institutional land use for soil pathway..

These measures might include:

- Excavating or remediating contaminated soil to levels that meet the criteria for unrestricted land use.

- Collecting soil gas samples at the units where inhalation of CVOCs via migration into indoor air is the risk pathway of potential concern. Soil gas sampling would provide the data to estimate risks more directly and accurately than the soil sampling data from which the potential risks were previously estimated.

- If not done previously, collecting additional soil samples to obtain a 95-percent upper confidence limit (UCL) on the arithmetic mean of the sample concentrations. This method is acceptable only if the sample size is greater or equal to eight and the percentage of non-detect values is less than or equal to 80%. As an alternative, calculating a spatially-weighted risk estimate might be proposed to DTSC, if the existing data do not indicate the presence of localized hot spots (areas of high concentration).

- If the unacceptable risk is based on a single sample result, collecting additional samples immediately adjacent to the outlier. This data would be used to show that either the elevated concentration is no longer present or the elevated concentration is extremely limited in horizontal and vertical extent. The area of the outlier could also be excavated if required by DTSC.

2.2 RESTRICTIONS AT RADIOLOGICAL UNITS

The United States Department of Energy (DOE) has specified restrictions on the use of the eight identified radiological units (Table 1). For the two inactive and abandoned radioactive waste storage tanks at Building 74, DOE did not release the structure, equipment, or area from any existing controls. In addition, the Building 75A Radioactive Waste Storage Area was specifically designated for reuse by the Berkeley Lab Radiation Protection Group, in accordance with Title 10 CFR 835 Occupational Radiation Protection at DOE Facilities. Institutional uses for these three units must comply with any controls set by the Berkeley Lab Radiation Protection Group. For the remaining five radiological units DOE stipulated that release of the areas to the general public was not authorized. All eight radiological units are therefore restricted from residential use. The locations of the eight units are shown on Figure 3.

SECTION 3

SOIL MANAGEMENT

3.1 OBJECTIVE

Berkeley Lab policy and federal and state regulations mandate that Berkeley Lab complies with environmental regulations governing the handling, transportation, and disposal of potentially contaminated soil. The objective of this section is to establish a policy and set of procedures for the management and disposal of waste soils generated during construction activities or other activities that might disturb contaminated soil at Berkeley Lab. Based on the site characterization data collected during the RFI, and the soil cleanups that have been completed, it is not anticipated that soil containing contaminants at hazardous levels will be encountered during future construction activities. However, soil containing contaminants that exceed regulatory levels for special handling, transportation, and disposal requirements may be encountered. Since the Berkeley Lab Waste Management Group has established policies and procedures for management and disposal of hazardous, radioactive, and mixed wastes generated by all Berkeley Lab activities, this Soil Management Plan provides the requirements only for non-hazardous and clean waste soil.

3.2 CLEAN, NON-HAZARDOUS, AND RADIOACTIVE SOIL

A *Soil Disposal Plan* (Berkeley Lab, 1993) was prepared by the ERP in December 1993 to manage the removal and disposition of waste soils generated during ERP field activities. The Soil Disposal Plan provides a detailed methodology for the selection of chemical analyses required to classify excavated soils. The detailed methodology is not included in this Soil Management Plan; however, the applicable excavated soil classifications are noted below.

<u>Clean Soil</u>

Clean soil is defined as soil which contains metals at concentrations within Berkeley Lab background levels and which is also not contaminated with hazardous organic compounds or radioactive substances. Table 3 lists the upper estimate of background concentrations of metals in the soil at Berkeley Lab (Berkeley Lab, 2002a). These values supersede the background soil values included in the Soil Disposal Plan (Berkeley Lab, 1993).

Table 3
Upper Estimates of Background Concentrations of Metals in Soil at Berkeley Lab (Berkeley Lab, 2002a)

Metal	Concentration (mg/kg)
Antimony	< 10
Arsenic (Great Valley Group)	42
Arsenic (other units)	24
Barium	410
Beryllium	1.1
Cadmium	5.6
Chromium	120
Cobalt	25
Copper	63
Lead	57
Mercury	0.5
Molybdenum	< 5
Nickel	270
Selenium	5.1
Silver	3
Thallium	10
Vanadium	90
Zinc	140

Non-Hazardous Soil

Excavated soil with detectable levels of hazardous substances that are below applicable Federal and California hazardous waste standards are classified as non-hazardous materials. This category would also include soil with concentrations of metals above the upper estimate of the Berkeley Lab background level but below the Federal and California hazardous waste standards. Hazardous waste standards are described in the Soil Disposal Plan (Berkeley Lab, 1993). Regulatory limits/standards noted in the Soil Disposal Plan should be confirmed to ensure that they are current. It should be noted that since the upper estimate of background is a statistically estimated value, concentrations above this value could still represent naturally occurring levels.

Radioactive Soil

Radioactive soil is defined as soil with detectable activities of radionuclides (i.e., curium-244 or tritium) above background levels.

3.3 EXCAVATION AND CONSTRUCTION ACTIVITIES

Preconstruction Evaluation of Soils

Prior to beginning any penetration action of ground or existing surfaces at Berkeley Lab, a Permit to Penetrate Ground or Existing Surfaces of LBNL Property must be obtained in accordance with requirements of Administrative Procedure (ADMN-053). Section 4.0 of the Procedure is a Ground or Existing Surfaces Penetration Job Safety Analysis (JSA) Checklist, which includes an Existing Contamination Evaluation as Item 48. The Administrative Procedure (ADMN-053) is included as **Attachment 1** to this Soil Management Plan.

After it is determined that soil is to be disturbed at a project site, the responsible individual/project manager or sponsoring-group representative will notify the Environmental Services Group (ESG) to initiate a preconstruction site evaluation. The ESG will then evaluate the proposed project location to determine:

- The nature and extent of any contamination known or suspected to be present in the soil
- Whether any preconstruction soil sampling is required

The initial evaluation will consist of a review of attached Figures 4 through 8, which show the known locations of CVOCs (Figure 4); PCBs (Figure 5); petroleum hydrocarbons (Figure 6); PAHs, SVOCs, metal/cyanide, pesticides (Figure 7), and radionuclides (Figure 8) in the soil at Berkeley Lab. The location numbers on the figures are cross-referenced to Table 1, which lists where detailed information on the nature and extent of contamination at each of the identified units can be obtained. The reference sources include the various RFI reports (Berkeley Lab, 1994, 1995, and 2000), the *Human Health Risk Assessment* (Berkeley Lab, 2003a), and the CMS Report (Berkeley Lab, 2005). Additional supporting information can be found in the RFA

Report (Berkeley Lab, 1992). Information on contamination of the soil by radionuclides can be found in the *Summary of Radionuclide Investigations* report (Berkeley Lab, 2003b).

Other factors will also be considered in the evaluation of sampling requirements. If a project site is located over an area of CVOC-contaminated groundwater, particularly over the core area of the contamination (See the *Groundwater Monitoring and Management Plan* [Berkeley Lab, 2006]), the presence of VOC contaminated-soil should be suspected. The historical function of buildings or other facilities present on the project site should also be considered. CVOC-contaminated soil should also be suspected to be present throughout most of the Old Town area of Berkeley Lab (area of Buildings 7, 14, 16, 25, 25A, 44, 52, and 53).

In certain cases, soil excavated from sites may not require sampling. For example, soil analysis may not be necessary if there is no known or suspected contamination, the soil is to be reused on site, and the excavation area is small. Previous analyses of soil in the area may also preclude the need to collect additional samples or may limit the number of supplemental samples that need to be collected.

<u>Construction Activities</u>

After completion of soil cleanup specified in the CMS Report, levels of known soil contamination will be at concentrations that do not pose a risk to site workers, including construction or landscape maintenance workers. Therefore, Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response (HAZWOPER) training will generally not be required of construction workers whose activities disturb the soil. However, HAZWOPER training may be required if there is also potential for contact with contaminated groundwater (Berkeley Lab, 2006).

If a sufficient number or type of pre-excavation soil samples was not collected to comply with landfill acceptance criteria or to document that the soil is clean, additional soil sampling will be required. Such samples can be collected from the soil as it is being excavated or from the soil stockpiles/bins. Excavated soil shall be managed in a way that will not cause sediment in storm water runoff. Excavated soil that is suspected or known to be contaminated shall be placed in covered bins or other sealed containers, or stockpiled and covered with plastic sheeting held in place.

Although project sites should be adequately characterized prior to construction, contaminated soil could be unexpectedly encountered during excavation. The Project Manager or sponsoring group representative is required to notify ESG immediately when suspected contamination is discovered. Construction or other work in the affected area shall be stopped, and the area shall be cordoned off until an evaluation can be made.

3.4 SOIL DISPOSAL

Clean Soil

Berkeley Lab has a strong commitment to waste minimization and pollution prevention to substantially reduce waste generation, increase recycling, and purchase "green" products. This policy applies to all site operations, associated support operations, and site contractors who generate any type of waste, including solid (office trash, construction and maintenance debris), hazardous, radioactive, and mixed waste. To support this policy, clean excavated soil will be reused onsite (such as for fill or other construction purposes), to the extent practicable. If on-site reuse is not practical or cost effective, clean waste soil will be disposed of in a Class III or other acceptable landfill. The landfill may require specific analytical testing to document that chemical concentrations do not exceed their waste acceptance criteria.

Non-Hazardous Soil

Non-hazardous contaminated soil will be disposed of in a Class II or other acceptable landfill, depending on the acceptance criteria of the landfill. The landfill may require analytical testing of the soil to document that chemical concentrations do not exceed their waste acceptance criteria.

Radioactive Soil

Radioactive soil will be disposed of in a facility licensed to dispose of Class A low-level radioactive wastes (LLRW), such as the Envirocare facility located in Clive, Utah. Approval for disposal must be obtained from DOE prior to offsite transport.

SECTION 4

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LIST OF FIGURES